

Rupture Process of the 2004 great Sumatra-Andaman earthquake estimated from tsunami waveforms

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Rupture process of the 2004 Sumatra-Andaman earthquake is estimated using five tsunami waveforms observed at tide gauges (Sibolga Belawan, Colombo, Vishakhapatnam, and Prot Blair) and tsunami height data obtained from two satellite altimetry data, “Jason-1” and “TOPEX/Poseidon”. The coseismic vertical deformation surveyed along the coast of Sumatra Island, Nicobar Islands, and Andaman Islands, are also used to constrain the fault model.

The slip amounts of 16 subfaults in the source area of the 2004 Sumatra earthquake was estimated using the tsunami waveform inversion. The varied rupture speed was also tested in the tsunami waveform inversion. The average rupture speed of the 2004 Sumatra-Andaman earthquake is estimated to be about 2 km/s from tsunami waveform analysis. The rupture extends about 1200 km toward north-northwest along the Andaman trough. The largest slip of 29 m is estimated on the plate interface near the trench off the northwest coast in the Aceh province in Sumatra. Another large slip of about 13m is estimated on the plate interface beneath the south of Great Nicobar Island in India. The other large slip of 10-15m is estimated on the plate interface near the other Nicobar Islands located toward the north of Great Nicobar Island. The slip amount beneath Little Andaman Island is about 5m, and that beneath the Middle and North Andaman Islands is small, about 1m. The total seismic moment is calculated to be 8.2×10^{22} Nm (M_w 9.2) which is slightly larger than the other seismological results, 6.5×10^{22} Nm. However, our estimate is smaller than that obtained from the other geodetic study, 8.8×10^{22} Nm, which includes the post-seismic slow displacement. Our estimated slip amount off Sumatra Island is larger than the slip amounts estimated by the seismological studies. This large slip should be responsible for large tsunami run-up heights of about 35m surveyed along the northwest coast of Aceh province in Sumatra Island.